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UNIRADICULAR PALSIES OF THE BRACHIAL PLEXUS.

BY E. FARQUHAR BUZZARD, M.B., M.R.C.P.,

Assistant Physician to the Belgrave Hospital for Children and Registrar to the National Hospital for the Paralysed and Epileptic.

The object of this paper is (1) to place on record six cases in which the symptoms pointed to a lesion of one of the spinal nerves forming the brachial plexus, (2) to discuss the sensory and motor phenomena produced by such a condition, and (3) to consider the anatomical site and pathological basis of the morbid process concerned.

I gratefully acknowledge my indebtedness to Sir W. Gowers, Dr. Ormerod, Dr. Beevor, and Dr. Taylor, for their kind permission to make use of cases under their care at the National Hospital, as well as to Dr. Sworder and Dr. Collier for notes on a patient whom they saw in private practice.

The diseased condition had an acute onset in the first three cases described.

Case 1.—J. J. P., a young man 25 years of age, was admitted to the National Hospital, under the care of Sir W. Gowers, on November 10, 1901. About a year previously, whilst acting as orderly in the R.A.M.C. in South Africa, he had a fall from a horse, which caused him no serious inconvenience or discomfort. Six weeks later he was attacked by acute pain in the right side of the neck and shoulder, which lasted about a fortnight, and which was accompanied by rapid wasting of the muscles in the shoulder girdle region. The loss of power and wasting reached their maximum in a month or six weeks, and then remained stationary up to the time of his admission into the National Hospital.

In the meantime he had been treated in South Africa and at the Nottingham General Infirmary. There had been no return of pain, and the patient complained only of inability to raise the arm at the shoulder.

On examination, the man, though slightly pale, presented the appearance of good general health and muscular development. The signs of disease consisted in atrophy and paralysis of the right supraspinatus, infraspinatus, deltoid and teres minor muscles, and in disturbance of sensation over an area roughly covering the deltoid muscle (see figs. 1 and 2).

The atrophy in the spinati and teres minor muscles was extreme, and no response was obtained to faradic or galvanic currents; a few fibres of the deltoid responded to strong currents, whilst the greater part of the muscle was unresponsive. The right biceps was no larger, and perhaps a trifle weaker, than the left, but it reacted well to stimulation by electricity. No affection of the supinator longus or brachialis anticus could be detected, nor of the trapezius, rhomboids, serratus magnus, pectorales, or diaphragm. It was not possible to detect any defect in function in the subscapularis.

As regards sensation, the area depicted in fig. 1 was quite analgesic; touches were felt there, but seemed different, according to the patient, to touches elsewhere; heat and cold sensibility was very defective over the same part, and the man thought he recognised heat with more difficulty than cold. Elsewhere the neuro-muscular system was normal, and no signs of visceral disease could be detected. After some weeks of treatment by massage and galvanism, symptoms of improvement began to set in with regard to the deltoid; and at the end of February, 1902, that muscle displayed very considerable voluntary power. A few fibres of the infraspinatus again began to function under volitional stimuli, and the area of analgesia was almost gone. The patient left the National Hospital early in March with a useful limb and with improvement still taking place.

In this case no etiological factor could be obtained from the man's previous history, and it is extremely unlikely that the trauma mentioned had anything to do with the condition. It may be added, however, that at the time of onset he was working very hard on half rations of food. No fever was associated with the early days of the disease.

*Case 2.*¹—A. O., a married woman, 40 years of age, came to the Hospital in February, 1901, and was treated as an out-patient under the care of Dr. Beevor. She came complaining of weakness in her right hand, and gave the following history.

¹ This case was shown by the author at the Neurological Society in March, 1901.



FIG. 1.



FIG. 2.



FIG. 3.



FIG. 4.



FIG. 8



Five years ago she was at Malta, and had an attack of Maltese fever. During convalescence she woke up one morning with pain shooting down the right arm from the neck and shoulder, and weakness of her right hand. The muscles of the latter slowly wasted, and have remained in a stationary condition ever since. The pain lasted a few days and then disappeared, to return from time to time for short periods. She was unaware of any numbness or loss of sensation.

On examination, there was found, in an otherwise perfectly healthy woman, marked atrophy of the muscles of the right thenar eminence, with partial atrophy and paresis of the interossei and long flexors of the fingers. At the same time an area of analgesia and thermesthesia, with slightly impaired sensibility to touch, on the inner surface of the forearm was detected. This area was somewhat oval in shape, and extended from a point just above the wrist to another just above the inner condyle of the humerus, the edges being fairly sharply defined (see figs. 3 and 4).

Electrical Reactions.—Practically no response to either current in thenar eminence, feeble contraction with faradism and galvanism in hypotenar muscles, interossei, and long flexors of the fingers, but no polar change and no qualitative change with the galvanic current.

The pupils and palpebral fissures were equal on the two sides. No improvement and no retrogression took place under treatment.

This patient was seen again after a long interval on June 6, 1902. The muscular wasting and sensory disturbance were in *statu quo*. The area of dissociated anaesthesia was tested by means of the cautery and ether spray (see Case 6), and the following results were obtained. The territory denoted in figs. 3 and 4 was insensitive to pin-pricks and to radiating heat, partially insensitive to cold vapour, and sensitive to tactile stimuli in a modified way (*i.e.*, the patient said they did not feel the same as elsewhere). At the same time I was struck with this fact: the fine point of a pin not only failed to give rise to painful sensations, but in most places failed to elicit tactile sensations. The cautery, placed in contact with the skin and raised to a moderate temperature, produced no sensation of heat nor any sensation but that of touch.

Case 3.—Mrs. W., aged 50, experienced sudden loss of power in left shoulder, with pain down the left side of the neck and shoulder, in June, 1900. This was followed, a few days later, by herpes, for which Dr. Sworder treated her. Recovery was slow, and in November, 1901, she was seen by Dr. Collier, who found atrophic palsy of left deltoid, supraspinatus and infraspinatus, with hardly any faradic response in any of those muscles. He also found some anæsthesia and analgesia of the fifth cervical root area, and the scars of herpes in the same region. There were adhesions in the shoulder joint, which were subsequently broken down, with the result that improvement rapidly took place, and when I saw her, early in this year, considerable voluntary power had returned and the sensory symptoms had practically cleared up. I learnt from her that she had had rheumatic fever when 19 years of age, and had suffered ever since from shortness of breath, faints, and cardiac pain. On examination there were well-marked signs of mitral stenosis. Unfortunately I have no accurate map of the anæsthesia or herpes distribution in this case; but in the present condition of our knowledge as to the significance of herpes, we may assume with a great degree of certainty that the lesion here was a vascular one, affecting the fifth cervical posterior root ganglion and spreading to the fibres of the anterior root at their junction with the posterior.¹

The following cases presented a subacute or insidious onset, progressed for a short period, but had for some time been stationary. Under treatment some improvement has taken place in certain of them.

*Case 4.*²—E. C., a girl in domestic service, 19 years of age, came to the Hospital on October 23, 1901, complaining of weakness of the right hand. When twelve years old the patient had scarlet fever, and an attack of chorea a year later was followed by a second attack four years ago. About that time she began to notice some flattening of the right thenar eminence and a gradually progressive weakness of the right hand. Very little alteration had taken place recently, and there was no extension of the disease to other parts. The onset and course of the condition had been unassociated with pain.

On examination the girl was well nourished and healthy

¹ This was the diagnosis arrived at by Dr. Collier when he saw her in November, 1901.

² This case was shown by Dr. Beevor at the Neurological Society on October 31, 1901.

looking, but complained of being short of breath on exertion. There were no evident signs of cardiac disease. Pupils and palpebral fissures were equal on the two sides. There was great atrophy of the abductor and opposens pollicis, less marked atrophy and weakness of the adductores and flexor brevis pollicis, much loss of power and atrophy in the interossei, hypothenar muscles, and long flexors of the fingers; there was loss of faradic and galvanic excitability in proportion to the wasting. The fingers presented a tendency to the "claw" position. On the inner side of the forearm there was an area of analgesia and thermanæsthesia, with partial loss of tactile sensibility, corresponding very closely in shape and size to that seen in Case 2 (fig. 5). No other abnormalities of a sensory, motor, or reflex character were present. Considerable improvement in regard to the sensory disturbance and slight increase of motor power has been observed under treatment.

Case 5.—E. M., a married woman, 33 years of age, has been attending at Queen Square as an out-patient under Dr. Ormerod's care for some years. When 18 years of age she suffered severely from anaemia, and was in a hospital for three months with that complaint. Shortly afterwards she noticed that her right hand would often "go cold," and subsequently she observed wasting in that part. This wasting has gradually progressed until, at the present time, most of the intrinsic muscles of the hand are affected, whilst the fore and upper arm are free from marked atrophy or paresis. On testing the sensibility an area of analgesia and relative anaesthesia similar to that in Cases 2 and 4 is detected on the ulnar aspect of the forearm. There are no signs of disease elsewhere, and the pupils and palpebral fissures are equal.

The heart and other viscera are healthy. The patient is free from pain, although in the past there have been attacks of aching down the inner side of the right arm.

The following case differs from those which precede it in the fact that two spinal nerves, the first dorsal and the fifth cervical, have both been affected, the one severely, the other slightly.

Case 6.—K. P., a domestic servant, 28 years of age, came under Dr. Taylor's care on February 20, 1902. Six years previously she had influenza, and for four years subsequently she suffered from trouble with her stomach. Her symptoms consisted of vomiting, haematemesis, epigastric pain, amenorrhœa, shortness of breath and palpitation of the heart, and three

years ago these troubles became so acute that she was treated in the Bristol Infirmary for four months. About two years ago she began to be conscious of clumsiness in her right hand, and found that she had difficulty in using her fingers, especially in cold weather. At the same time wasting of the thumb was noticed, and attacks of pain in the arm, which have recurred at intervals since, caused a certain amount of discomfort. She does not think that the hand is more wasted now than it was eighteen months ago, but she has more difficulty in straightening the ring and little fingers on that side. This, no doubt, is due to the fact that a certain amount of post-paralytic contracture has occurred in the hand similar to that which has been described in ulnar neuritis by J. De Léon (1), who compares it to the facial contracture so common in Bell's palsy, and names the condition "main en pince."

On examination there was found, in addition to the contracture just described, marked wasting and loss of power in the abductor opposens and adductores pollicis, considerable atrophy and weakness of the interossei, lumbrales and hypothenar muscles, with the exception of the abductor minimi digiti. In the forearm the deep and superficial flexors of the fingers were atrophied and weak, whilst the pronator radii teres and wrist flexors had escaped. The pronator quadratus was probably also affected, although of this it was difficult to be sure.

The wasted muscles showed a corresponding loss of electrical excitability. The right deltoid was slightly less powerful than the left, but it was impossible to detect any difference between the strength of the external rotators of the arm on the two sides. There was no evidence of injury to the oculo-pupillary fibres which leave the cord with the first dorsal root.

Over a part of the first dorsal root area on the ulnar side of the forearm there was slight impairment of tactile sensibility, with marked but not complete thermaesthesia and analgesia. Over a part of the fifth cervical area (see fig. 6) there was slight decrease of sensibility to pain and heat, whilst that to touch and cold was practically normal. Both areas were tested carefully for heat and cold by means of a cautery (in close proximity to the skin) and by an ether spray, with the object of eliminating, as far as possible, the tactile element during the test. In this way it was ascertained that the loss of sensibility to heat over the first dorsal area was more complete than that to cold, whilst the condition over the fifth cervical area was as noted above. The presence of a red-hot cautery close to the skin gave rise to no sensation, either tactile, painful or thermal.



FIG. 5.



FIG. 6.



On the other hand it appeared that when the wire of a galvanocautery was held in contact with the skin, and then heated by the passage of a current to a temperature sufficient to raise a small blister but not sufficient to change the colour of the metal, a painful "prick" was experienced by the patient. She did not associate the sensation with heat. This last test, however, was applied after some improvement had taken place in the sensory disturbance. The knee-jerks were brisk, there was no ankle clonus, and the plantar reflexes were flexor in type. The left arm was unaffected, although for a short time she complained of pain in that part. No signs of organic heart disease could be detected.

Under electrical treatment the contracture has much improved, and there appears to be more power in some of the affected hand muscles, while, as above stated, the hyperaesthesia has also undergone some change for the better.

One of the most noteworthy features of the cases just recorded lies in the fact that three of them suggest a lesion of the first dorsal nerve, two of them a lesion of the fifth cervical nerve, and the sixth a lesion of both these nerves. This may be a coincidence, or it may point to a special susceptibility on the part of the lowest and highest roots of the brachial plexus; on the other hand, it is well to remember that a corresponding lesion of any one of the intervening roots does not admit of such ready diagnosis. The anterior primary divisions of the lower four cervical and first dorsal spinal nerves form a small system devoted to the motor and sensory supply of the forelimb, and the overlapping in their peripheral distribution is necessarily greater in the middle than at either end of the system. Thus there is little mingling of the territories of the fourth and fifth cervical or of the first and second dorsal nerves. A striking analogy is afforded by the special nomenclature attached to injuries of the upper and lower trunks of the same plexus, and it is permissible to regard my cases as representing either half an Erb's palsy or half a Klumpke's palsy, the former involving the fifth and sixth cervical nerves, the latter the eighth cervical and first dorsal.

MOTOR PHENOMENA.

A careful study of the sensory and motor phenomena in Case 1 leaves no room to doubt that the incidence of the

morbid process was on that part of the fifth cervical nerve which lies between the junction of its anterior and posterior roots and its union with the sixth nerve to form the upper trunk of the plexus.

In this patient there was no evidence of paresis in the rhomboids, levator anguli scapulae or serratus magnus, and it is fair to assume that the disease was situated peripheral to the branches which, in part, supply these muscles, and which arise from the nerve as it lies between the scaleni. In Case 3, however, the occurrence of herpes points to an extensive lesion, involving not only the posterior root ganglion, but the anterior root-fibres at their union with the posterior, and if the rhomboids were not affected the explanation must be supplied by a statement of Grenet, who says:—"Assez fréquemment le nerf de l'angulaire et du rhomboïde naît du plexus cervical et non du plexus brachial. L'angulaire et le rhomboïde peuvent donc rester indemnisés dans le cas de paralysie radiculaire intrarachidienne" (2).

The distribution of atrophic palsy in Case 1 supplies valuable evidence of the motor innervation from the fifth cervical nerve, and it is interesting to note that the limitation of this innervation to the spinati and teres minor, a great part of the deltoid, and probably a few fibres of the biceps, is supported by the anatomical researches of Herringham (3). The latter, as a result of careful dissections of the brachial plexus and its roots in a large number of subjects, makes the following statements: (1) It is usually at the junction of the fifth and sixth nerves that the suprascapular nerve is given off, but it is not uncommon to find it springing from the fifth before the junction is made. (2) The sixth, therefore, exercises sometimes an extremely small influence, and sometimes none at all, over the spinati. (3) It appears that the pectoralis major does not usually receive from the fifth. (4) The biceps is supplied by fifth and sixth seven times out of eight. (5) Thirty-one dissections showed no exceptions to the rule that the fifth does not enter into the outer head of the median nerve. (6) The circumflex comes from the fifth and sixth; in six cases from fifth alone; sixth

branch often very small. (7) The teres minor is always supplied by the fifth alone. (8) The supinator longus and brevis are usually supplied by the sixth; the fifth is not always excluded.

The upper part of the subscapular muscle also receives a supply from the fifth cervical nerve, but its affection would not lead to a demonstrable disturbance of function.

In Cases 2, 4, 5 and 6 there was present a partial atrophic palsy of certain muscles of the hand and forearm, and although the amount of atrophy varied slightly in individual instances, the same muscles were affected in all. These were the long flexors of the fingers slightly, the interossei considerably, and the muscles of the thenar and hypothenar eminences in varying degrees.

Herringham maintains that the first dorsal nerve sometimes supplies in part the flexores profundus and sublimis, the interossei, the hypothenar and deep thenar muscles, but he does not consider that the superficial thenar muscles receive any innervation from the same source. At the same time he admits the greater difficulty in tracing the fibres of individual roots as far as their terminations in the peripheral as compared with the proximal portions of the limb.

Sherrington (4) finds, too, that the superficial intrinsic thumb muscles receive, segmentally considered, a less posterior motor innervation than the deep intrinsic thumb muscles in the higher vertebrates, and finds in this fact an exception, which he is at a loss to explain, to the rule that the more superficial muscles are supplied by lower segments than those lying deeper in the same part of the limb.

If any value can be attached to clinical cases such as those which form the basis of this paper, the same difficulty does not appear to obtain in man, because in some of them the abductor pollicis showed a very considerable degree of atrophy, equal to that presented by some of the deeper thenar muscles. On the other hand, it was noticeable that a part of the flexor brevis pollicis sometimes escaped.

In Charcot's (5) patient, who suffered from a traumatic lesion of the first dorsal nerve, there was marked atrophy of the hypothenar eminence, less marked atrophy of the thenar

eminence, atrophy of the interossei and slight atrophy of the flexors in the forearm, but the author does not state whether the superficial or deep intrinsic muscles of the thumb had suffered more severely. His case, however, supports mine in the distribution of the motor affection.

A comparison of Cases 1 and 3 with 2, 4, 5 and 6 brings out the fact that the wasted muscles in the former were fewer, and generally more profoundly atrophied, whilst in the latter they were more numerous, and sometimes less completely affected. This observation conforms with Sherrington's (6) statement that there is greater overlapping and commingling of the root districts in the muscles of the hand than in those of the shoulder, in the peripheral than in the proximal parts of the limb.

At the same time it must be admitted that the degree of atrophy which obtained in certain of the hand muscles was much greater than might have been at first sight expected if the innervation of only one out of two or more spinal roots had been cut off; but the effect of such a condition on the nutrition of a muscle, especially if untreated over a long period of time, is at present a matter requiring further investigation. The absence of oculo-pupillary symptoms, and of any history of herpes in the instances of first dorsal nerve lesion, justifies the conclusion that the point of injury was situated in the nerve between the junction of its roots and its union with the eighth cervical to form the lower trunk of the brachial plexus. Disease of the spinal cord itself is further excluded by the absence of any signs of spasticity in the lower limbs.

SENSORY PHENOMENA.

There are a few points of considerable interest in connection with the sensory phenomena present in these patients.

The dissociative character of the anaesthesia in the cutaneous root areas was as marked as is often the case in syringomyelia, and may be regarded as evidence of the greater overlapping of the tactile as compared with the algesic and thermal fields in the peripheral distribution of a single afferent root. This fact was pointed out by Charcot some years ago in the case cited above, and was especially

referred to by him in drawing a comparison between his patient and examples of syringomyelia.

The algesic area may therefore be regarded, not as the whole territory of root distribution, but rather as that of residuary analgesia after all compensation by overlapping has taken place. For this reason the area alluded to is of smaller dimensions than that over which herpes appears in disease of the corresponding posterior root ganglion, smaller, too, than the region to which pain is referred under similar circumstances ; and lastly, smaller than the district in which tactile sensibility is probably but almost inappreciably modified. An interesting observation on the part of Rendu (7) is worthy of quotation in the present context. In a case which was recorded by him as one of reflex neuritis, but the symptoms of which pointed, in my opinion, to a local lesion at the junction of the fifth and sixth cervical nerves, the pain was described as being of two kinds : (1) contusive in character and confined to the shoulder region, (2) intermittent sharp stabs darting from the cervical region to the tips of the fingers. The anæsthesia was limited to the area which was the seat of pain of the first kind.

Turning to the experimental work carried out by Sherrington (8) on "The Spinal Roots and Dissociative Anæsthesia in the Monkey," the conclusions drawn by that distinguished observer may best be referred to in their original words.

(1) "The disturbance of skin sensation produced in *macacus* by severance of spinal roots is to some extent a dissociative one.

(2) "In *macacus* the destruction of a single sensory spinal root, at least in the case of certain spinal nerves, entails in a limited skin-area, much smaller than the total skin-field of the root, an abolition of heat sensitivity without abolition, but with some concomitant impairment, of tactual sensitivity.

(3) "In the skin of *macacus* the 'pain'-field and the 'heat'-field of a single sensory spinal root, at least in the case of certain spinal nerves, are each less extensive than is the 'touch'-field of the same root.

(4) "With the 'heat'-fields and 'pain'-fields of the roots the extent of overlap is greater in some skin regions than in others, *e.g.*, in the hand and foot than in parts of the forearm, thigh and trunk."

The area of dissociative anaesthesia produced by dividing the first dorsal posterior root in *macacus* is, according to Sherrington's photographs, of smaller extent than that in man, the upper limit falling short of the elbow.

A remarkable feature of my cases was the absence of any subjective sensation of numbness in the hypaesthesia skin. Not one of the patients was aware of his sensory loss until the fact was demonstrated to him. This forms a striking contrast to the subjective numbness in injuries to peripheral nerves, and I would suggest that it may probably be reckoned as an important factor in the diagnosis between a root and a peripheral nerve lesion.

ETIOLOGY AND PATHOLOGY.

It is customary to group under the name "neuritis" all gross lesions of nerves which are not caused by trauma or by the pressure or encroachment of some external morbid process, and this custom finds a close analogy in the application of the term "myelitis" to all transverse lesions of the spinal cord, whether they are of inflammatory or vascular origin. For some reason not easy to explain, similar processes in the brain are better distinguished; cerebral haemorrhage and thrombosis on the one hand, and encephalitis on the other, are accepted terms amongst diseases of the highest part of the nervous system. Whilst it is clear that there is need for reform in regard to this loose classification of diseases of the spinal cord, it may be urged that our knowledge of peripheral nervous lesions is not sufficiently advanced to warrant any attempt to adopt a more exact terminology than that which is obtained by the title "neuritis." The absence of anatomical evidence to support clinical theory is certainly a serious hindrance to any such attempt, but it is difficult to feel satisfied with a nomenclature which does not draw distinctions between a symptom-complex, suggesting a sudden localised interruption of

functional continuity in a single spinal nerve, and a gradual affection of many nerves, probably due to the presence of some morbid influence in the general circulation.

When the help of the microscope is wanting it is necessary to consider the etiology of any particular disease in order to obtain guidance on the problem of its pathology. In Case 1 of my series, short rations and hard physical work are the only items of importance in the remote or immediate previous history of the patient.

In Case 2 the onset of symptoms occurred during convalescence from Malta fever, a disease which bears many clinical resemblances to rheumatic fever, and which is frequently associated with marked anaemia and joint troubles.

Case 3 was the subject of mitral stenosis in the sequel of acute rheumatism.

In Case 4 scarlet fever, followed by two attacks of chorea, were prominent features in the few years immediately preceding the onset of the nervous phenomena.

Cases 5 and 6 were the victims of very severe chlorosis, accompanied, in the latter, by all the symptoms of gastric ulceration.

I submit that the above facts suggest, with reasonable probability, a special liability on the part of these patients to lesions of vascular origin. Such lesions may and do occur in various parts of the body without giving rise to noteworthy symptoms when their incidence is upon vessels of small calibre. Their occurrence, however, in any part of the nervous system cannot fail to produce striking disturbances of function, even when the vessel affected is little more than capillary in size. Embolism of the retinal artery has more than once been recorded in association with chorea (9), and Mr. Marcus Gunn (10) has noted symptoms pointing to haemorrhage into the sheath of the optic nerve in women suffering from amenorrhœa.

Is it unreasonable to infer that spinal nerves may also be the seat of localised vascular changes, sometimes sudden and sometimes insidious in their onset, and leading to a train of symptoms to which the term "neuritis" is indiscriminately applied? If this possibility is admitted, there is

plenty of evidence to suggest that such vascular lesions may occur not only in the brain, spinal cord, and cranial and spinal nerves, but also more peripherally still in the cords of the brachial plexus and the nerves of the extremities. Remak (11), indeed, has proposed the name "acute multiple localised neuritis" for cases presenting the clinical features suggested by that designation, and cites a case where the symptoms pointed to sudden and almost simultaneous lesions of the suprascapular and circumflex nerves on the right side, and of the musculo-cutaneous nerve on the left.

Other cases of musculo-cutaneous palsy, occurring suddenly and alone, are recorded, and in some, such as that described by Hoffmann (12), the area of sensory loss was the seat of subjective numbness. But other nerves are equally commonly affected in this manner, and these are only mentioned in order to emphasise the similarity of the sudden onset with pain, paralysis and atrophy, whether the lesion be situated proximal to, peripheral to, or in the midst of, the brachial plexus.

Many cases of herpes zoster have a striking general resemblance to this group, and are in rare instances (*e.g.*, Case 3) associated with motor disturbances. Although the existence of a specific affection of the posterior root ganglia has been established beyond all doubt by the admirable work of Head and Campbell (13), it is questionable whether some cases of zoster are not dependent on purely vascular lesions, and, indeed, whether some cases cited by those authors in their series of autopsies were not of this nature rather than toxic in origin. They admit the probable vascular origin of at least one case, where an extreme necrotic lesion was found in the 12th dorsal ganglion, but in a case of multiple focal lesions of the cord due to endarteritis obliterans the changes in the diseased ganglion are ascribed to a specific unknown agent, to the influence of which the spinal disease is supposed to have rendered the patient especially predisposed.

I proffer the suggestion that under certain circumstances a vascular lesion may originate (α) in a spinal root ganglion, giving rise to herpes zoster and, if the lesion is extensive, to

motor as well as sensory phenomena; (b) in a spinal nerve, when it will occasion the symptom-complex presented by my cases; (c) in a nerve-trunk formed by the union of two or more spinal nerves, resulting in a condition of which Erb's palsy is the commonest example; and (d) in a peripheral nerve, causing a localised peripheral neuritis.

Such a view does not preclude the probability that the vascular lesion may be primarily due to some diseased state of the blood or of the blood-vessels, and that its incidence on particular nerves or portions of nerves may be favoured by anatomical peculiarities of which we are at present unaware.

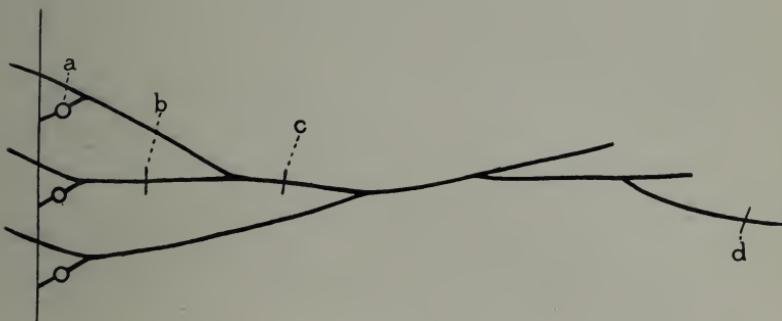


FIG. 7.—Diagrammatic representation of the four sites of neuritic localised lesions (see text).

Whatever be the nature of the morbid process concerned in cases of acute or subacute "localised neuritis," it is certain that an extension of our knowledge can only be gained by the careful examination of nerves from their origin to their peripheral distribution when the opportunity is afforded. The practice of only investigating a short length of nerve is not calculated to throw light on the matter, and may be considered analogous to removing a short piece of the spinal cord at an indifferent level for the purpose of studying the nature of a transverse myelitis.

LITERATURE.

Lesions of the brachial plexus, medical, surgical and obstetrical, figure very frequently in English and Continental medical literature, and much has been written about their

causation and symptomatology, especially by Erb (14), Duchenne, Klumpke (15), Secretan (16), Dejerine (17), Raymond, Rendu, Bernhardt, Duval (18), Guillain, Grenet, Zuelzer (19), Stadelmann (20), and others.

These authors refer almost entirely to injuries of its upper and lower trunks, or to injuries affecting all the roots which go to form the plexus. Even the exhaustive monographs on this large subject make but brief mention of uniradicular paralyses. Thus, Duval and Guillain (18) say that uniradicular palsies are very rare, and only mention the "bullet wound" case of Charcot.

Under the heading "Paralysies Uniradiculaires," Grenet (2) says, "Il n'y a pas lieu d'insister sur ces faits qui ne paraissent pas très fréquents."

Secretan's (16) solitary contribution to the subject is contained in the following words:—"Dans un cas de Traube, un ostéome vertébral détermine une lésion de la 8e. c. et une atrophie des muscles de la main et de l'avant-bras."

Head (2) says that he has seen a case of herpes zoster in which the eruption over the first dorsal area was associated with palsy of the movements of the hand and fingers, but he supplies no further details.

Cases of zoster in the region of the trigeminal nerve, accompanied by oculo-motor or facial paralysis, of which there are many instances, can hardly be considered comparable, but it is possible that some examples of brachial palsy and herpes collected by Ebstein (22), although imperfectly recorded, may have been allied to one described in this paper.

Lewis Jones (23) has published some cases of atrophic paralysis in one or both hands, and it may be that his Case 6 belongs to the same class as mine, but there is no mention of sensory disturbance.

The sudden and spontaneous onset of Erb's palsy, with no preceding trauma, is not uncommon, and the character of the initial symptoms suggests a similar pathological factor to that of my first three cases, although its anatomical site is not quite identical. At the same time it must be remembered that the difference of a fraction of an inch in the position of the actual morbid process would suffice to provoke

a fifth cervical nerve palsy instead of an Erb's palsy. Such variations in position readily account for the minor differences in the physical signs, and often point to a greater or less involvement of the sixth cervical nerve at its junction with the fifth.

The scope of this paper, however, does not admit of reference to the numerous cases of brachial plexus palsy, arising from disease of more than one of its roots, or of the trunks formed by their union.

In conclusion, attention may be drawn to the remarkable fact that whilst Charcot's case is often referred to as an instance of injury to a single spinal nerve, little or no notice has been taken of his interesting observations on the character of the sensory loss produced, observations which have received experimental confirmation by Sherrington, and clinical support, I venture to believe, from this paper.

CONCLUSIONS.—(1) There exists a clinical group of cases in which the symptoms strongly suggest a more or less complete destruction of functional continuity in one of the spinal nerves forming the brachial plexus.

(2) The objective disturbances of sensibility resulting from this lesion closely conform with those observed by Sherrington after cutting a posterior root in a monkey. They differ in some respects from the anaesthesia produced by the division of a peripheral nerve.

(3) The anaesthesia is largely dissociative in character, and does not occupy the whole cutaneous area to which the afferent fibres of the spinal nerve are distributed.

(4) The objective hypaesthesia is not associated with any subjective sensation of numbness, and is consequently overlooked by the patient.

(5) The atrophy of the affected muscles is in excess of what might be expected in view of the fact that many of the muscles receive fibres from two or more spinal nerves.

(6) The condition generally occurs in persons who have at some time been the subjects of a disease affecting the cardio-vascular system. The morbid process is probably vascular in character, and may be sudden or gradual in its onset.

Since writing the above, another interesting case of the kind has come to my notice.

Case 7.—C. H., aged 28, metal turner, complains of loss of power and wasting in his right hand, and of attacks of dull aching pain down the right arm.

Previous history.—Typhoid fever twelve years ago. Injury to skin of right upper arm six and a half years ago, healed in eight days. Six years ago influenza, followed by congestion of the lungs; three months ill. No venereal disease.

Present illness.—About five years ago he noticed gradual wasting of right thenar eminence, preceded by pain in the shoulder and arm. The atrophy and weakness has spread to its present extent slowly.

Now, the abductor and opponens pollicis are much atrophied, the flexor brevis and adductores less so, and there is some wasting and weakness of the interossei, hypothenar muscles and long flexors of fingers. Electrical reactions are altered in corresponding degree. On the inner side of the right forearm there is an area of very marked analgesia and loss of sensibility to heat, with considerable impairment of sensibility to touch and cold. From the upper limit of this area a narrow strip of skin, extending into the axilla, also presents a similar sensory loss (see fig. 8). In this case it seems probable that the lesion is situated in the first dorsal nerve, and involves not only the fibres of that nerve, but also some sensory fibres which properly belong to the second dorsal nerve, and which reach it by a branch from the first to the second. Such a branch is present in a certain percentage of human subjects, and is almost constant in some of the higher vertebrates, but whether its fibres are afferent or efferent I am not aware. The explanation of the condition must be sought in such a supposition, or in two lesions, one involving the first and the other the second dorsal nerve. It is extremely interesting to note that the tactile hypæsthesia in this patient is more marked than in any of those previously recorded, and that he alone of all my cases was aware of his sensory loss. This might have been expected from what has been said above, as the sensory fibres of two adjoining spinal nerves are evidently affected.

The pupils and palpebral fissures are equal. The heart and other viscera are healthy, and there are no nervous phenomena elsewhere.

Note.—The present paper is devoted to the consideration

of this disease when its incidence is upon the roots of the brachial plexus; is it possible that the lumbo-sacral plexus may at times be similarly affected, and that some cases of sciatica with muscular atrophy (24) may have an analogous pathological basis?

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DESCRIPTION OF FIGURES.

FIGS. 1 AND 2.—*Case 1*, T. T. P. Showing area of dissociated sensory loss and atrophy of muscles.

FIGS. 3 AND 4.—*Case 2*, A. O. Showing area of dissociated sensory loss and muscular atrophy.

FIG. 5.—*Case 4*, E. C. Showing area of dissociated sensory loss and muscular atrophy.

FIG. 6.—*Case 6*, K. P. Showing areas of dissociated sensory loss and muscular atrophy.

FIG. 8.—*Case 7*. Showing the first and second dorsal areas where sensory loss was present.

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